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High School
Course of Study Series

PART TWO
SECTION V

SCIENCE

Published by
DEPARTMENT OF PUBLIC INSTRUCTION
TERRITORY OF HAWAII
September 1, 1927

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Hawaii (Territory) Department of
Public Instruction
gift
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Sections Included in Part Two
of
High School Course of Study Series

Section I. COMMERICIAL

(Prepared in Mimeograph form only)

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Agriculture—Auto Mechanics—Metal Working—Mechanical Drawing—Woodworking.

Section IX. MISCELLANEOUS

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INTRODUCTION

Feeling the need for a more complete standardization of high school work, a tentative Course of Study was drawn up in 1924 with the cooperation of the high school principals. This Course of Study was put out in mimeographed form for experimental use in all high schools of the Territory. As the result of invited criticisms and suggestions, a revision was mimeographed in 1925. It was then expected that the Course of Study would be printed in 1926. The "Teachers' Manual" was published September 1, 1926, as Part I of the High School Course of Study Series. The separate courses of study themselves were delayed until 1927, so that more changes might be incorporated.

Although this Course of Study has gone through three revisions, it is still far from complete, because changes in both theory and practice must be made continually if any school system is to keep abreast of the needs of its students. This series is, however, offered now in printed form, so that it can have a wider distribution. It is hoped that every teacher will take a keen interest in interpreting the subject matter of the classroom to fit the individual needs of the students, and that this Course of Study outline will be suggestive and helpful in leading the way.

The separate courses of study have been worked out entirely by the schools themselves, through the splendid cooperation and loyal effort of both principals and teachers. Special thanks are due the High School Course of Study Committee, which has compiled and revised the completed series. The committee is as follows:

General Chairman

Mr. Miles E. Cary, Principal of McKinley High School.

Central Committee

Mr. J. P. Buller, Vice-Principal, McKinley High School.
Mr. James R. Coxen, Territorial Director of Vocational Education.
Mrs. Lura J. Loader, Teacher of English at McKinley High School.
Mr. Oren E. Long, Deputy Superintendent of Public Instruction.
Mr. T. M. Livesay, Professor of Education, University of Hawaii.
Mr. Robert R. Spencer, Principal of Washington Junior High School.
Dr. Ross B. Wiley, Director of Research, Department of Public Instruction.
Mr. Benj. O. Wist, President of the Territorial Normal School.

General Committee

Mr. F. A. Clowes, Principal Leilehua High School.
Mr. Clyde E. Crawford, Principal, Konawaena High School.
Mr. F. E. Howard, Principal, Maui High School.
Mr. W. Harold Loper, Principal, Kauai High School.
Mr. Richard E. Meyer, Principal, Hilo High School.
Mr. H. Alton Rogers, Principal, Lahainaluna High School.
Mr. Harlan M. Roberts, Principal, Kohala High School.

WILL C. CRAWFORD,
Superintendent of Public Instruction.

High School Course of Study Series
Part Two

Section V—Science

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High School Course of Study Series

PART TWO

GENERAL STATEMENT

The central aims of secondary education have been outlined in Part One of the high school course of study. An attempt will be made in the following outlines to establish a basis for the actual class-room procedure in accordance with those aims.

Those persons who have been closely associated with the work of the various committees will realize that it has been a tremendous task to harmonize the work of some seventeen committees where the members of all committees (except the Central Committee) were scattered throughout the islands.

THE GENERAL PLAN

In order that all committees might have a common point of departure in their work the following basic directions were drawn up by the Central Committee:

1. Be specific in your statements; generalizations often lead afield.
2. Secondary education is more concerned with the activities of the individual than it is with making the student's mind a storehouse of information.
3. In so far as possible every teacher and every recitation is concerned with the three elements of social efficiency, namely: efficiency of government, efficiency of industry, and efficiency of home. In other words our various subjects are not so many airtight compartments each concerned only with a narrow range of purposes. Each teacher who works on the course of study should endeavor to see that through the pupil activities, provided for in each subject, definite growth will be realized in the direction of the **socially efficient** individual.
4. Examine all of your contributions in the light of the major aims of education as outlined in Part One of the Teachers' Manual.
5. A minute arrangement of the subject matter by weeks and months is not wanted. Every teacher, worthy of the name, is capable of doing this. But what is wanted is a general outline of the basic amount of work to be covered by each subject.
6. It is expected that slower pupils will not be able to cover the basic amount of work outlined in each subject. Modifications in subject matter will need to be made for slow students.

The following quotation, taken from the National Education Association research bulletin entitled, "Keeping Pace with the Advancing Curriculum," was adopted by the Central Committee in order to establish the dominant tone of these outlines:

> "The teacher is a trained observer who guides the interests of her pupils into activities that are purposeful and which have social value. In the classroom, the subject-matter is still subordinate to activities. Whereas the teacher has clearly in mind a unified and carefully organized core of subject-matter, she does not rigidly require that it shall be covered in any set order."

The course of study outlines which follow represent the work and interest of many persons. These outlines have been printed in pamphlet form for the convenience of teachers. However this does not mean that the course of study work is complete. This work can never be complete, but must continuously give due consideration to the needs of our ever changing society. However, with these outlines as a point of departure each teacher is urged to carry forward the work; and the real test of the value of these outlines will be the extent to which they are used.

It should be clearly understood by all that these outlines are a guide, rather than a hitching post.

SCHOOL ECONOMY

CLASSROOM ECONOMY: This is an essential factor in school work. Every minute wasted is a loss of as many minutes as there are students in the class. This may amount to many hours, even days or weeks for the school year. Efficiency is the watchword in both business and education. Classroom economy demands:

1. **Beginning work at the ringing of the last bell—or before if the class is assembled.**
2. **Seating of students so that roll may be called by inspection in a fraction of a minute.**
3. **Good order at all times—loud talking and boisterous conduct should not be allowed even between classes.**
4. **Attention to the work in hand—reading papers, preparing lessons for other classes, and sitting listlessly should not be tolerated.**
5. **That assignments be definite and clear, and at the beginning of the recitation period; unless the principles under discussion lead logically to new principles to be assigned for study later.**
6. **System in passing out papers, laboratory material, books and supplies.**
7. **Proper ventilation and adjustment of shades to regulate the light.**
8. **Cheerfulness at all times and occasional praise for excellence as incentives for good work.**
9. **Prompt dismissal at the ringing of the first bell.**

STUDY-HALL ECONOMY: The following rules should be firmly enforced:

1. Independent work on the part of every student.
2. Order—no whispering or talking.
3. Punctuality.
4. Industry.
5. System in roll call.
6. System in dismissing students to go to the library.

HALL ECONOMY: A great deal of time is wasted in the halls and corridors. Tardiness is frequently due to this fact. This waste may be reduced to minimum if students are urged:

1. To walk lively, but orderly.
2. To follow the rule of keeping to the right, or left, as the case may be.
3. To take the shortest route.
4. To refrain from whistling and boisterousness at all times.
5. To take pride in good order and promptness to class.

During school hours the school is a work shop. If teachers are able to establish in the school the same spirit of work and application which one expects to find in a work shop then the school will be approaching the ideal in the matter of working efficiency.

SOME FUNDAMENTAL CONSIDERATIONS

It should be the desire of each high school teacher to give every student, who comes under his instruction, a training commensurate with the capacity of that student.

This is also the aim of the Department of Public Instruction. The general aims of secondary education have been outlined in Part One of this series.

The primary purpose of Part Two is to outline in a general way the aims and content of each subject offered.

This procedure seems to be necessary in order to coordinate the work of the various secondary schools of the Territory.

But in addition to outlining the formal work of each class, it may also be necessary to add a suggestion or two regarding the place which the formal subject matter should play in the class work:

1. The subject matter of any course should be considered as a means to an end, rather than the end.
2. If the subject matter of a course is to be used as a tool then the student should know how to use this tool, or tools. In general the student should be led to use his facts and skills in the solution of problems. The problems, or projects, should be those which have an appeal to the student; better, they should be the student's problems. If, as has just been stated, subject matter is a tool it must be a tool to some end. It must serve some purpose. For the teacher to be conscious of this purpose is not enough. The pupil must also be conscious of it. Otherwise that which is intended to serve him as a tool is mere useless rubbish to him. Furthermore, it should be borne in mind in this connection that purpose must exist **before** tools are needed—**not after.** The teacher may assist the student in discovering worthwhile and interesting problems. But the student's response is apt to be poor if the teacher arbitrarily assigns problems which interest her, regardless of the interests of the students. As experience amply proves, it is almost impossible to interest every student in a class. But if each teacher will keep in mind that interest generally precedes learning, then a great deal of waste of human energy may be avoided—for the teacher as well as the pupil.

When the teacher faces her class at the beginning of a term, she is not prepared to meet the full responsibility and opportunity of the occasion unless she can answer the following questions, without qualifications, in the affirmative:

1. Am I prepared to teach this subject?
2. Do I see each student as an individual, eager for all that I can give of my store of knowledge and inspiration?
3. Do I consider character training to be of more importance than the giving of information?
4. Knowing that boys and girls learn largely by imitation and emulation, am I willing to order my own conduct, both in school and out, in harmony with the ideal for which I am expecting the students to strive?
5. Am I willing to be a personal friend of each student in my class?
6. Am I willing to give more than is outlined in the textbook and manual?

If each teacher can answer these questions in the affirmative, then the high schools will prosper, and each student will go forth well equipped to meet the tremendous and complex demands of modern society.

SCIENCE

GENERAL AIMS OF SCIENCE:

1. To interpret natural laws in terms of the pupil's own individual and social efficiency.
2. To train the student for observation of the interesting and beautiful features and phenomena of his material environment.
3. To train the student in the scientific method of investigation and to draw conclusions only after a careful investigation has been made.
4. To give the student an understanding of the fundamental laws governing his physical environment.
5. To teach the students the romance of modern science. Specialization and an emphasis upon technical features should be delegated to the college or university.

SUBJECTS INCLUDED IN SCIENCE:

Agriculture.
Astronomy.
Biology.
Chemistry.
Geology.
General Science.
Elementary Science.
Physics.

AGRICULTURE

AIMS—FIRST YEAR:

1. To give some vocational guidance.
2. To give an appreciation of agriculture as a basic industry.

AIMS—SECOND YEAR:

1. To develop some understanding of the chief problems of agriculture in Hawaii.
2. To give first hand information and experience in some elementary phase of agriculture.

ELEMENTS OF THE COURSE:

First year:

General Agriculture—overview of the general field of agriculture.

1. Basic text—
   Robbins—Principles of Plant Growth. (John Wiley)
2. Special references—
   (a) World Geography.
   (b) Fletcher—Soils. (Doubleday, Page & Co.)
3. Printed materials on Hawaii.
4. Department Bulletins.
5. Field Trips.
6. Class problems and projects.
7. Talks by men engaged in agriculture.
8. Project for each student.
9. Class work.
   a. Basic text—
   Waters and King—Animal Husbandy. (Ginn)
   Davenport—Plant and Animal Improvement. (Ginn)

Second year:

1. **Population Studies.**

   By means of charts, graphs and other methods of visual comparison studies of world population and distribution of same may be made.

2. **Production Studies.**

   By suitable methods, e. g. as above, world production of basic agricultural commodities with special emphasis upon the ones vital to Hawaii should be presented.
   References:
   World Geography.
   Year Books.

3. **Occupations.**

   Study of occupations in Hawaii based on population in relation to our basic industries; graphic presentation desirable.
   References:
   Census Report.

4. **Explorative Analysis.**

   Inquiry concerning our established, or nearly established, industries relative to the following factors:
   a. Working Conditions.
      (1) Income.
      (2) Hours.
      (3) Health, etc.

- b. Continuity.
    - (1) Permanence.
    - (2) Opportunity for advancement.
    - (3) Nature of work.
- c. Living Conditions.
    - (1) Cost of living
    - (2) Housing
    - (3) Social advantages.

Pre-arranged visits to various industries where a close-up of occupations may be observed.

SCIENCE STUDIES:

First year:

1. Robbins—Principles of Plant Growth. (John Wiley)
    - a. List of desirable experiments. These experiments are based on the text and should precede the subject matter of the text.
    - b. Sample form for experiment and data recording.
    - c. Field trips.
    - d. Demonstrations.
2. Fletcher—Soils. (Doubleday, Page & Co.)
    - a. List of desirable experiments.
    - b. Field trips.
    - c. Demonstrations.

References—World Geography.

Second year:

General study of animal husbandry.

Text—Waters and King—Animal Husbandry. (Ginn)

By means of following the text, taking up those subjects related to the islands. The chapter on sheep, for instance, would be eliminated and replaced by bulletins relating to topics important to Hawaii: Poultry, for example.

The laboratory work in connection with Animal Husbandry should consist of a series of field trips—one laboratory period each week.

Suggested field trips:

1. Honolulu Dairymen's. (1) Pasteurization.
2. Fair. (2)
3. Kamehameha School. (Judging several classes of live stock —swine, cattle, beef, etc.) (4)
4. Hind-Clarke Dairy. (Sanitation; housing methods.)
5. An army post where horses are found. (Draft-Saddle.)
6. University of Hawaii. (Poultry, beef, etc.)
7. Experiment Station, U. S. (Poultry, beef, etc.)
8. Poultry Farm. (Poultry, fruits, macadamia nuts, Robinson Bros., Grant Bailey, Manager.)
9. Piggery.
10. Quarantine Station. (1)
11. Board of Forestry and Agriculture. (1).
12. Packing House. (1)
13. Market. (2)
14. Punahou School Farm. (1)
15. Plant Quarantine.

The field trip is to be one of not merely observation, but actually judging animals by a prescribed method. Arrangements can be made with the managers of the various enterprises visited.

Appreciation of Some of the Problems of Agriculture Through Practical Activities in Form of Projects.

Which presupposes that every member of the class must have some **very definite** opportunity to carry on some form of small scale agricultural work, **otherwise the boy should not be allowed to take the course.**

Examples of projects:

1. Garden.
2. Apiary.
3. Pigeons.
4. Poultry.

Note: Where a boy has work in some agricultural pursuit, he may substitute this work for his project.

Suggested way of handling the whole course throughout the year.

Week's Outline—Suggestive: 3 single periods, 2 double periods.

1. Tie whole class to the textbook for the three single periods.
2. One double period allotted for the field trip.
3. One double period, one-half of which allotted to group and individual conferences, one-half to be turned over to individual reading of the boys' own choice.

Note: The foregoing outline need not be too closely followed.

Many good reference books are available at the school library which should be kept in the agriculture room. Others found to be necessary should be ordered.

EXAMPLE OF AN EXPERIMENT WRITTEN UP

Note: Blank sheets should be mimeographed for the students' individual use for each experiment.

Experiment No.........................

Title: Osmosis.

Apparatus and Material:

Carrot—glass tube 5 in. long.
Sugar solution.

Procedure:

Replace stem of carrot with glass tubing—stand ¾ of carrot in sugar solution. Let stand for several hours.

Results:

Conclusions:

Experiments to be given in Chapters (suggested):

Chapter II

1. Draw one or more cells and label the parts.
   - a. Nucleus.
   - b. Nucleolus.
   - c. Cell activity.
   - d. Cell wall.
   - e. Vacuoles.
   - f. Cytoplasm.
   - g. Protoplasm.
   - h. Near the apex of the leaf or along the midrib find the chloroplast. How does it move?
2. Cell division—root top of an onion.
   - a. Chromosome.
   - b. Poles.
   - c. Linin.
   - d. Chromatin.
3. Stem structure—cross section of cane or corn. Monocotyledon.
   Identify following tissues:
   - a. Xylem.
   - b. Phloem.
   - c. Trachenchyma.

    - d. Parenchyma.
    - e. Vascular bundles.
- 4. Dicot.
    - a. cambium layer.
    - b. annual ring.
    - c. medullary ring.
    - d. epidermis.
    - e. parenchyma.
    - f. cortex.
    - g. cork cambium.

Chapter III

- 5. Leaf structure—Fiscus elastic—rubber plant.
    - a. upper epidermis.
    - b. lower epidermis.
    - c. water storage tissue.
    - d. palisade tissue.
    - e. spongy parenchyma.
    - f. vascular bundle (phloem, xylem).
    - g. stomata.
- 6. Absorbing cells—root hair—seedling (transverse).
- 7. Osmotic Phenomenon (reverse of).
  Use Nacl 0.1 0.4 0.7 1.0
  also KN03 gram molecular.
  Place in each solution the lettuce seedlings.
  Compare and explain what is peasmolysis.

Chapter IV

- 8. Heat—a form of energy—work.
  10% solution of cane sugar—yeast and formalin.
- 9. Diversion of cane sugar.
  Sugar solution and yeast.
  Sugar solution and distilled water.
  Relation to sugar industry.
- 10. Experiment showing different kinds of sugars.
  Monosaccharid.
    - glucose.
    - frutose.

  Disacchrid.
    - maltose.
    - sucrose.
    - lactose.

  Polysacchrid.
    - starch.
- 11. Show by means of plants at hand the storing up of energy in different forms.
    - a. latex.
    - b. vil.
    - c. sugar.
    - d. starch.
    - e. protein.
    - f. others.
- 12. Digestion—
  Determine digestion of starch by enzymes.
  Starch and distilled water—test with iodine.
  Examine grains under microscope.
- 13. Examine under microscope starch grains of potato, banana, corn, canna, pea, bean, rice, taro.

Chapter VI

- 14. Place carnation shoots, or other suitable plant, slightly wilted, in aqueous solution of cosin; cut off two inches and note time required to show color. When all are colored cut transsections and note. Split stem in halves and note distribution. Results and conclusions.

After 30 minutes, or 1 hour, cut off two inches from stem end—cut under solution. Note change in rate of coloration of veins. Why were the ponds formed in the leaves? Why cut the ends under the solution of water? What is Xylem?

15. Molds. (Bread mold on bread.)
    Drawings showing parts, and asexual and sexual reproduction. (Drawings)
    Mushroom—spore case, etc.

Chapter VII

16. Set up a potometer and measure roughly the rate of transpiration.
17. To determine the influence of stomata on evaporation. Use cobalt paper—filter paper dipped in cobalt chloride and dried.

Chapter VIII

18. Respiration—germinating soaked peas.

Chapter IX

19. a. Grow corn or radish seedlings in the chamber provided and study the appearance, distribution, etc., of the root hairs—draw.
    b. By sprinkling clean, fine sand over the moist paper and noting intimate contact of sand and root hairs—draw.

Chapter XI

20. Parts of the flower.
21. Pollination and Fertilization.
    Germinate pollen grains on stigma of papaya.
22. Reproduction.
    sexual.
      cross pollination (seed).
    asexual.
      grafting—budding (bud).

Chapter XII

23. Swelling of seeds—water of imbibition.
    a. scarification.
    b. demonstration of force—breaking jar.
24. Liberation of energy—starch.
    Rise of temperature when water is added to dry starch.
    Absorption of water through seed coats.
      pumpkin, sunflower, castor bean.
25. **Seed** (Monocot—corn).
    Explain by drawing:
      a. cotyledon.
      b. coleoptile.
      c. radicle.
      d. embryo.
      e. plumule.
      f. scintillum.
      g. endosperm.
      h. coleorhiza.
    —(Dicot—castor bean)
      a. embryo.
      b. endosperm.
      c. phalaga.
      d. micropyle.
      e. plumule.
      f. cotyledon.
26. **Effects of acids on albumen.**
27. **Water as a carrier.**
    5 samples of air dried peas; place a sample in—
      a. tightly stopped bottle.

b. 95% alcohol—keep in room temperature.
c. 50% " — " " " "
d. 15% " — " " " "
e. water.
Next laboratory period weigh and germinate.

28. Germination. Effect of heat.
Peas.
Air-dry—4 temperatures—
95°—45°—75°—85°
Soaked—4 temperatures—
95°—85°—75°—45°
What is critical temperature?

Chapter XV

29. Water a pot of seedlings with 30°C water.
Remove stem 1 in. above earth and note exudation commonly called bleeding—what about maple sap?
    a. Effect of a dry layer of soil upon evaporation from a free surface—what is dry farming?
    b. Turgor—use Calla lily—keep tissues moist.
    Measure on note paper.
        a. Length—with two sides of cortex.
    c. Length with cortex removed.
    d. Length one side cortex removed.
    Further drawings in order of removal of cortex strips.
Why doesn't bleeding take place in all trees when cut?

30. Guttation.
    a. Pot of seedlings watered with 30°C water—place under bell jar. Remove drops as formed at leaf tip.
    Note time required to form. What is dew?
    b. Repeat (a) but do not allow drops to form; instead, sprinkle leaves with a little dry cosin and expose to dry air. Explain.
    What is eye spot? Study some by means of microscope.

31. **Displacement of air by water of imbibition.**
Kill some beans by high temperature and soak and measure.

Chapter XVII

32. Place a sprig of Elodia, or any water plant, in a test tube, cut end uppermost.
Count bubbles when exposed to:
    a. diffused light.
    b. weak direct light.
    c. strong light.
Collect gas and apply oxygen test.
What is photosynthesis?
What is one of the by-products?

33. Chlorophyll.
    a. Heat certain green leaves to 80°C in water; drain and superficially dry them. Cover them with 95% alcohol, place beaker in water bath at 60°C and extract for 15 minutes. Don't use an open flame.
        (1) Examine by transmitted light.
        (2) Examine by reflected light.
    What is flourescent solution?
    b. Add turpentine, equal parts; explain.
    c. To 2CC add 1 drop of HC1. Explain.
    To two samples add some powdered CuSo4.
        (1). Place in light. Explain.
        (2). Place in dark. Explain.
        (3). By means of rainbow or glass prism explain light and colors.
        Explain spectroscope, if one is available, and show absorption of light by using different depths of chlorophyll.

(4). Relative solubilities and absorption.
Extract chlorophyll by using methyl alcohol and petroleum ether.
Place strips of filter paper in leaf extracts made with ethyl and methyl alcohol and petroleum ether, respectively; note separation. By means of extracts of varying depths note colors up to total absorption.

34. Test the leaf of the white margined pelargonium for starch.
Note region of starch.
Place plant in dark for 2 days and test for starch.
Explain.
What is translocation?

Chapter XVIII

35. Show enzymatic action on soluble starch by means of malt extract and test with Potassium Iodide solution.

Chapter XX

36. Grass family.
Cane-corn.
Give exercise in identification and method of classifying plants.

Chapter XXII

37. Yeast plant-cell-fungus.
   a. vacuole.
   b. protoplasm.
   c. spore.
   d. bud.
   e. etc.

Chapter XXIX

38. Flow of sap—red dye or cosin.

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      a. F. C. Bishop and H. P. Wood. (U. S. Dept. of Agric.)
         Mites and Lice on Poultry. (Farmer's Bulletin 801)
      b. Eye Worm of Chickens. (Hawaii Agri. Exp. Station)
         (Press Bulletin d3)
      c. Kaupp, Benjamin F.
         Poultry Culture, Sanitation and Hygiene.
         (W. B. Saunders & Co.)
      d. Lewis, Harry R.
         Productive Poultry Husbandry. (J. B. Lippincott Co.)
      e. Robinson, John Henry.
         The Common Sense Poultry Doctor.
         (Bost. Farm-Poultry Publishing Co.)
         16 chapters, 176 pages.
      f. Woods, P. T.
         How to Raise Chicks. (Am. Poultry Journal Pub. Co.)
      g. Pearl, Raymond
         Poultry Diseases. (Macmillan)
      h. Valentine, C. S.
         The Beginner in Poultry, pp. 103-131. (Macmillan)

Animal Husbandry

The Americana, Vol. 6.

Hogs

The Americana, Vol. 20.
The New International Encyclopedia, Vol. 4.
The New International Year Books, 1914 to 1925.
The Standard Reference Work, Vol. III and IV.
The Encyclopedia Britannica, Vol. V.
The Encyclopedia Britannica, Vol. XIII.
The Atlantic Monthly, pp. 388-92, Vol. 135, March 1925.
Farmer's Bulletin, pp. 1-22, 1925; Vol. 1455.

Gardening

Kate L. Brewster—The Little Garden for Little Money. (Atlantic Monthly, 1924)
Martineau—Gardening in Sunny Lands. (Appleton)
Bailey—Principles of Vegetable Gardening. (Macmillan)

Bailey—Manual of Gardening. (Macmillan)
Bennet—Vegetable Garden. (Burt)
Beattie—Celery Culture. (Judd)
Corbett—Garden Farming. (Ginn & Co.)
Duggar—Mushroom Growing. (Judd)
Croy—Putnam's Vegetable Book. (G. P. Putnam's Sons)
Greiner—Onion Culture. (Judd)
Wickson—California Vegetables. (Pacific Rural Press, San Francisco)
Lloyd—Productive Vegetable Growing. (Lippincott)
Hall—The Garden Yard. (McKay)
Allen—Cabbage, Cauliflowers, Etc. (Judd)
Kruhm—The Home Vegetable Garden. (Judd)
Rexford—A B C of Vegetable Gardening. (Harper)
Rexford—The Home Garden. (Lippincott)
Morrison and Grues—How to Make the Garden Pay. (Houghton)
Selden—Everyman's Gardening in Wartime. (Dodd)
Sevey—Bean Culture. (Judd)
Watts—Vegetable Gardening. (Judd)
Pan-American Magazine, pp. 150-9, Vol. 60, Feb., 1926.
Science (Press), Vol. 60, pp. 12-14, Dec. 5, 1924.
Farmer's Bulletin, Vol. 1437, pp. 1-30, 1925.

Cattle

Farmer's Bulletin, Vol. 1395, pp. 1-44, 1925.
Overland, Vol. 84, pp. 35-36, Feb., 1926.
American Historical Association Report, pp. 307-22, 1920.
Saturday Evening Post, Vol. 198, pp. 12-3, Nov. 28, 1925.
Outlook, Vol. 138, p. 705, Dec. 31, 1924.
National Geographic Magazine, Vol. 48, pp. 591-710, Dec., 1925.
Country Life, Vol. 48, pp. 62-70, May, 1925.
Country Life, Vol. 49, pp. 85-86, Dec., 1925.
Country Life, Vol. 47, pp. 66-7, Aug., 1925.

Cattle

Newland, H. Osman: "The Romance of Modern Commerce." (J. P. Lippincott)
Twombly, Francis Doan: "Romance of Labor," pp. 157-98. (Macmillan)

Swine

Swine Raising in Hawaii, Bulletin No. 48, 1923 (Hawaii Agri. Exp. Station)

Live Stock

Plumb, Charles Summer: "Lessons in Animal Husbandry." (Hall & McGreary)
Plumb, Charles Summer: "Types and Breeds of Farm Animals." (Ginn)

Cattle

Farmer's Bulletin, Vol. 1218, pp. 1-34, 1921.
Farmer's Bulletin, Vol. 1379, pp. 1-18, 1923.
Farmer's Bulletin, Vol. 612, pp. 1-31, 1921.
Country Life, Vol. 44, pp. 87-8, Sept., 1923.
Bulletin Pan-American Union, Vol. 56, pp. 476-83, May, 1923.
Travel, Vol. 43, pp. 14-17, Jan. 1924.
Scribner's Magazine, Vol. 73, pp. 417-26, April, 1923.
Saturday Evening Post, Vol. 197, pp. 28-29, Oct. 11, 1924.
Review of Reviews, Vol. 69, pp. 541-2, May, 1924.
Country Life, Vol. 42, pp. 70-1, Sept. 1922.

Poultry

Poultry Diseases and Their Control,
Sperry Service Extension Bulletin,
Sperry Flour Company.

How to Develop Layers,
  Sperry Flour Company.
Save the Babies,
  Sperry Flour Company.
Chicken Pox,
  Sperry Flour Company.
Cold, Catarrh, Roup,
  Sperry Flour Company.
Capon Gold,
  Geo. Beuoy,
    Cedar Vale, Kansas.
U. S. D. A.
  Poultry House Construction.
  FB No. 1413.
First Care of Baby Chicks.
  Board of Animal Industry, U. S. D. A.
Poultry Houses,
U. S. D. A. Farm Bulletin 1113.
Poultry House,
  International Library of Technology.

How to Raise

Sperry Poultry Guide.
Standard Varieties of Chickens.
U. S. D. A. FB. 1347, 1-2-3-4-5.
Selection and Preparation, Fowls for Exhibit.
U. S. D. A. FB. 1115.

ASTRONOMY

AIMS OF ASTRONOMY:

1. **To give the student some appreciation of the planet on which we live, and its comparative place among the planets and stars.**
2. **To reveal to the student the many practical uses of the principles underlying the science of astronomy.**
3. **To give students an appreciation of astronomy as a science as expressed by La Place in:**

> **"Contemplated as one grand whole, astronomy is the most beautiful monument of the human mind, the noblest resort of its intelligence."**

PUPIL ACTIVITIES INTENDED TO REALIZE AIMS:

1. Make drawings of earth, planets, and sun showing relative sizes and distances apart.
   Encourage students to make a model solar system showing comparative sizes of planets, and distances apart.
2. Suggested problems—
   a. How did the early Hawaiians use the stars to guide their ocean voyages?
   b. How does the moon influence the tides?
   c. How do we know scientifically that the earth is not flat?
   d. In what way does a modern ship depend upon astronomy for guidance? Visit a ship's pilot house.
3. Devise simple experiments to illustrate some of the principles of astronomy—(suggestive)—
   a. Finding the true North.
   b. Measuring the diameter of the Sun.
   c. Make a sun compass such as was used by Byrd on his airplane flight over the North Pole.
   d. The Bubble—sextant used by Byrd.
   e. Borrow a ship's sextant for laboratory study.
   f. Ask an engineer to demonstrate the use of his level and compass, etc.

TEXTBOOK (Required)

Todd—New Astronomy. (American Book Co.)

USE OF THE TEXTBOOK

The instructor will find that Todd's Astronomy is much too detailed and extensive for a one-semester course in high school. For this reason much of the book dealing with technical and mathematical details should be omitted.

It may prove helpful to divide the students of a class into groups, and have each of these groups report on a different chapter, using original drawings and other illustrative materials to visualize and vitalize the discussion.

So far as possible this study should be approached from the standpoint of the problem method.

BIBLIOGRAPHY FOR STUDENTS:

Abbot—Earth and Stars. (Van Nostrand)
Hinks—Astronomy. (Henry Holt & Co.)
Ball—Starland. (Ginn & Co.)
Newcomb—Sidelights on Astronomy. (Harpers)
Johnson—Sky Movies. (Macmillan)
Johnson—Star People. (Macmillan)
McKrealy—Beginners' Guide to the Stars. (Putnam)
Houston—The Wonder Book of Light. (Stokes)
Martin—The Friendly Stars. (Harpers)
Young—The Sun. (Appleton)
Verne—Journey to the Moon in a Projectile. (Imaginative) (1918, Scribner's.)
Boy Scout Pamphlets on Astronomy.
Ball—The Story of the Heavens. (Cassell)
Newcomb—Astronomy for Everybody. (McClure, Phillips)
Serviss—Curiosities of the Sky. (1909, Harper, 9-29243)
Newcomb—The Unsolved Problems of Astronomy. (An essay) (Harper & Bros.)

BIOLOGY

AIMS OF BIOLOGY:

1. To acquaint the student with and interest him in the various forms of life.
2. To teach the interrelationship of living organisms.
3. To give an intelligent understanding of the development, structure and function of the human organism.
4. To apply the principles of hygiene and health in everyday life.
5. To show the economic importance of plants and animals.

PUPIL ACTIVITIES INTENDED TO REALIZE AIMS:

1. **To acquaint the student with and interest him in the various forms of life.**
   - a. Through discussion and reading, call pupils' attention to the numberless forms of life all around us; to their influence on human life; to the men who have worked and are working to understand, control and improve the various types of life; and to the many fascinating books and periodicals available to make us better understand the living things around us.
   - b. Study carefully parts and functions of typical organisms from any available books, charts and specimens.
   - c. Field trips, both class and individual, will acquaint student with types of life in this locality. These should be so planned and directed as to supplement class work and to arouse an active interest in nature's wonders. A love of the outdoors can form a basis for profitable spending of leisure time.
   - d. Individual projects based on student's special interests will not only enlarge each student's experience, but through reports to class will enrich everyone's acquaintance with the various forms of life.
2. **To teach the interrelationship of living organisms.**
   - a. Make a comparative study of the structure and habits of the different forms of life.
   - b. To show how all living things are fundamentally alike, take various functions of protoplasm and show how the different types perform these functions. This can be done through making of charts, outlines, and summaries based upon reading and laboratory work.
   - c. Special investigations of the way each type of living thing modifies and is modified by others.
   - d. Keeping an aquarium in the classroom. This should be a true balanced aquarium and a study of the way in which this shows the interrelationship of all living things should be made.
   - e. Field trips.
3. **To obtain an intelligent understanding of the development, structure and function of the human organism.**
   - a. Have students determine man's place as an animal. Here a study of the progressive change among all living things from the simple to the complex, will give an understanding of the development and structure of each part of the human animal.

b. Make a careful study of structure of each part of the human body. Use this as a basis for a study of the care of the body.

c. Projects, both class and individual, may be worked out. For example, the preparation of a progressive series of charts, or preserved specimens, to show the development of the digestive, nervous and other systems either from very simple to human animals, or from simpler to higher vertebrates.

4. **To apply the principles of hygiene and health in everyday life.**

   a. Students work together to formulate a simple group of health rules.

   b. As a class project work out a health program for the class. Such a program, to be successful, should result in improving the health of the individuals of the class.

   c. Projects here may include special study of various phases of local health problems, the work of the Board of Health, food laws and enforcement, and similar problems.

5. **To show the economic importance of plants and animals.**

   a. Make a special study of local plants and animals in their relation to industries and prosperity of the community.

   b. Projects might include collecting and studying about local insect pests, following experiments on plant breeding in the cane and pineapple work, a study of the forestry work and many similar activities.

6. **Some general suggestions for pupil activities:**

   a. **Have regular reports made by students on current articles of biological importance in reliable magazines and papers.**

   b. **Have a student committee to keep a good live bulletin board for Biology.**

   c. **Use material gathered in "a" and "b" as well as other material brought by students as material for scrap books to be kept up by a committee of students. These could be a class project with various books for different subjects as insects, industries of Hawaii, etc.**

   d. **A class project in constructing a "Who's Who" in Biology with a committee to formulate and organize the materials gathered.**

   e. **Formation of Biology club.**

   f. **Pupil activities in the laboratory to be on the project basis.**

TEXTBOOKS (Optional)

Hunter—New Essentials of Biology. (American Book Co.)
Hunter—New Civic Biology. (American Book Co.)

OTHER MATERIALS TO BE USED:

Supplementary texts and other books.
Charts and models.
Sharpe's Manual for Hunter's Biology and other manuals. (American Book Co.)
Standard laboratory equipment for Biology.
Pamphlets and illustrative materials from the experiment stations and extension service of various places.

SUGGESTED ARRANGEMENT OF TEXTBOOK MATERIALS BY SEMESTER:

First Semester—

Chapters 1-15. The parts and functions of plants and their relation to man and other animals.

Second Semester—

Chapters 15-end. The study of animals leading up to man, giving especial emphasis to the health habits of man.

BIBLIOGRAPHY FOR TEACHERS

Twiss—The Teaching of Science. (Macmillan)
Ganong—The Teaching Botanist. (Macmillan)
Lloyd and Bigelow—The Teaching of Biology. (Longmans)
Jordan—Foot Notes on Evolution. (Appleton)
Arnold—The Sea Beach at Ebb Tide. (Century)
Walter—Genetics. (Macmillan)
Clement—Biology of Living Things. (Iroquois Pub. Co.)

BIBLIOGRAPHY FOR STUDENTS

A good list of references is given at the end of the various chapters in the text.
de Kruif—Microbe Hunters. (Harcourt)
Ritchie—Human Physiology. (World Book Co.)
Bolton—Famous Men of Science. (Crowell)
Conn—Bacteria, Yeasts, and Molds in the Home. (Ginn & Co.)
Cunningham—Adventures in Science. (Ginn & Co.)
Fabre—Social Life of Insects. (Century)
Maeterlinck—Life of the Bee. (Dodd)
Periodicals—Scientific American, Hygeia, Nature Study, National Geographic, Popular Science, Science and Invention.

CHEMISTRY

AIMS OF CHEMISTRY 1 AND 2:

1. **To show the service of chemistry to the home, to medicine, to agriculture, to industry, etc.—in a word, to show the service of chemistry to modern life.**
2. **To train the student in keen observation and exact thinking.**
3. **To build upon the earlier science courses and knit them in the best possible manner.**
4. **To help students find themselves—i. e. to discover whether they have an aptitude for further study in chemistry, or applied science; and if so, to encourage such students to continue their study of science in the university, or technical school.**
5. **To give the students an appreciation of the "romance of modern chemistry."**

PUPIL ACTIVITIES INTENDED TO REALIZE AIMS:

1. **To show the service of Chemistry to the country.**
   a. Pupils may study different processes and activities in home, industry, etc., from a chemical viewpoint.
   b. Each topic or subject taken up in class and laboratory work to be studied to see if it has an application in the home, industry, etc.
   c. Field trips to local places of scientific interest (canneries, sugar mills, etc.) planned, attended, and discussed from a chemical viewpoint.
2. **To train the student in keen observation and exact reasoning.**
   a. All laboratory work should be carried out by the scientific method of experiment (definite problem, plan method, do experiment, observe results, draw and apply conclusions).
   b. All laboratory and demonstration experiments should be done and observed accurately and clearly.
   c. Pupil demonstration experiments during recitation periods will encourage careful study and preparation and will also tie up the laboratory and recitation periods.
   d. Pupils should keep a note book of laboratory findings.
3. **To build upon the earlier science courses, and unify them (usually General Science and Biology).**
   a. Students should be led to regard Chemistry and all sciences as branches of Science, with no strict dividing line between them.
   b. Students should find and discuss examples of correlation of all science.
4. **To help students find themselves; or discover their interests and abilities along the lines of chemistry and applied science.**
   a. Students should be encouraged to do individual project laboratory work rather than the stereotyped laboratory exercises.
   b. Students should be encouraged to develop chemistry hobbies (such as photography, small home laboratories, etc.) if their interest and ability lie that way.
   c. Individual problems should be assigned whenever possible to take the place of set experiments of the manual.
5. **To give the students an appreciation of the "Romance of Modern Chemistry."**
   a. Keep a bulletin board for all general and local news of chemical interest from magazines and newspapers.

b. Free discussion on certain days of any related chemical subject, not based on textbook or classroom work.
c. Encourage students to give talks and demonstration-experiments on special problems and topics; groups of students working together will frequently get a great deal from such projects, and problems.

TEXTBOOKS (Required)

Brownlee and Others—Elementary Principles of Chemistry. (Allyn and Bacon)
Brownlee and Others—Laboratory Exercises in Chemistry. (Allyn and Bacon)

OTHER MATERIALS TO BE USED:

Supplementary texts and other books.
Notebooks.
Laboratory equipment adequate to perform the experiments for this course.
Charts and any visual instruction material obtainable.

SUGGESTED ARRANGEMENT OF TEXTBOOK MATERIALS BY SEMESTER:

First Semester—

Chapters 1-19 with the corresponding laboratory experiments. Stress the quantitative side both in experiments and problems.

Second Semester—

Chapters 20 to the end. The chapters on the Periodic Law and Radium Nugat to be used as supplementary reading. Any course in general chemistry must stress the importance and occurrence of the Carbon Compounds. Much attention during the second semester should be given to qualitative reactions and analysis.

BIBLIOGRAPHY FOR TEACHERS

The Journal of Chemical Education.

BIBLIOGRAPHY FOR STUDENTS

Findlay—Chemistry in the Service of Man. (Longman)
Duncan—Chemistry of Commerce. (Harpers)
McPherson and Hen.—Chemistry and Its Uses. (Ginn & Co.)
Hendrick—Everyman's Chemistry. (Harpers)
Rogers and Aubert—Industrial Chemistry. (Van Nostrand)
Martin—Triumphs and Wonders of Modern Chemistry. (Nostrand)
Sadtler—Chemistry of Familiar Things. (Lippincott)
Phillip—The Romance of Modern Chemistry. (Lippincott)
Thorpe—Essays in Historical Chemistry. (Macmillan)
Duncan—The New Knowledge. (Barnes)
Bailey—Source Chemistry and the Use of Food Products. (Blakiston)
Newth—Inorganic Chemistry. (Longman)
Rahlenberg—Outlines of Chemistry. (Macmillan)
Lassahr-Cohn—Chemistry in Daily Life. (Dulad-London)
Bird—Modern Science Reader. (Macmillan)
Smith—Chemistry in America. (Appleton)
Phillip—Achievements in Chemical Science. (Macmillan)
Sherman—Chemistry of Food and Nutrition. (Van Nostrand)
Howe—Chemistry in the World's Work. (Nostrand)
Arrhenius—Chemistry in Modern Life. (Van Nostrand)
Carney—Outline of the Methods of Chemistry Analysis. (Geo. Wahr, Ann Arbor, Mich.)
Slosson—Creative Chemistry. (Century)

ADVANCED CHEMISTRY

This course has not yet been offered in any high school.

GEOLOGY

AIMS OF GEOLOGY:

1. To make a study of the physical geology of the earth—beginning with Hawaii.
2. To give some understanding of the methods, principles, and facts of historical geology.

PUPIL ACTIVITIES INTENDED TO REALIZE AIMS:

1. Field trips—to study the physical features of the neighborhood; what forces have operated to give Hawaii the physical features which she possesses today?
   Make a collection of different kinds of rock specimens—classify.
   Make a study of topographic and geologic maps in the laboratory.
   List and study recent striking changes and movements in the earth's crust.
   Study the artesian basin of Oahu. Make drawings showing mountains, sea, and rock formations supporting the artesian basin.
   Study water conservation program outlined by Honolulu Sewer and Water Commission.
2. Make a study of fossils.
   How is earth's life-story revealed by its surface features?
   What story does a coal mine tell? A limestone cliff? A sandstone rock? A gravel bed? Etc.
   In what geologic period was Hawaii built up from the ocean bed? Which island is the oldest? Etc.
   Use pictures and fossils in connection with study of various geologic periods.

TEXTBOOK (Required)

Blackwelder and Barrows—Elements of Geology.
(American Book Co.)

Suggestions regarding use of textbook:

The textbook should be used largely as a manual. The course should be made as practical and interesting as possible by centering the study as much as possible upon illustrations and conditions in Hawaii.

The following sections should be especially emphasized:

Surface structures of igneous rocks
Vulcanism
The work of the atmosphere
The work of waters underground
The work of streams
Oceans and lakes
The great features of the land
History of the earth
Origin and development of the earth

Students should be given a general overview of the various geologic periods.

OTHER MATERIALS TO BE USED

Common rocks and minerals
Topographic and geologic maps
Specimens, pictures and pamphlets available through U. S. Volcano Observatory, Kilauea, Hawaii.

GENERAL SCIENCE

AIMS OF GENERAL SCIENCE:

1. **Exploration of the field of science and of the pupil himself—his aptitudes and interests.**
2. **To give the pupil an understanding of the world in which he lives and of its everyday phenomena.**
3. **To train pupils in scientific methods of problem solving.**
4. **To study the scientific principles underlying the basic industries of Hawaii.**

PUPIL ACTIVITIES INTENDED TO REALIZE AIM:

1. **Exploration of the field of science and of the pupil himself—his aptitudes and interests.**
    a. Emphasize the romance of modern science, the purely interesting features.
    b. Individual projects with reports and experiments before the class. These should follow the lines of individual interest. Projects often worked out in connection with "hobbies" (radio, photography, etc.)
    c. Have students consider questions, 'How May I Make Use of Science in My Home, in My Community?" Lists made answering this. Comparison then to be made with book contents.
    d. Debates on scientific questions.
    e. Popular scientific writers (such as Slosson)—read and discuss.
    f. Construction of a "Who's Who" in Science as a class project.
    g. Free discussions of any scientific subjects whatsoever at regular times.
2. **To give the student an understanding of the world in which he lives and of its everyday phenomena.**
    a. Student demonstrations of the scientific principles underlying the common processes and activities in the home and community.
    b. Connect up all textbook work with actual observation and experiment.
    c. Field trips to local places of scientific interest (dairies—street car plant, etc.)
    d. Keep a bulletin board for all general and local news of scientific interest from magazines and newspapers.
3. **To train pupils in scientific methods of problem solving.**
    a. Have students keep clearly in mind the steps in scientific method (problem, method, experiment, result, conclusion.)
    b. Have all class experiments performed and discussed from viewpoint of scientific method.
    c. Have students apply scientific method to all problems in general, to consider that conclusions can not be drawn until evidence from every possible source has been gathered.
4. **To study the scientific principles underlying the basic industries of Hawaii.**
    a. Field trips wherever possible to canneries, plantations, etc., and with these a study of the scientific principles involved in various phases of these industries.
    b. Individual projects with detailed study of various phases of the industries. For example: a study and collection of insects harmful to sugar cane or pineapple; a study of machinery used in a cannery or sugar mill; a study of experiments now under way to improve any phase—such as breeding in sugar cane. These should be real projects and not just special reports.

5. **General suggestions:**
   - a. The work should be arranged in large units, relating all parts to the larger units, thus unifying the whole year's work.
   - b. A sound purpose for the whole course and for each smaller unit should be established in such a way that the pupil will approach his work with the active attitude of an investigator, rather than with the passive attitude of studying so many pages.
   - c. Combine out-of-school experiences with individual laboratory work and pupil and teacher demonstrations. Individual projects and demonstrations entail individual responsibility and initiative, both of which develop active learning attitudes.
   - d. A definite objective for field trips should be carefully planned in advance in order that they may be taken as serious work.
   - e. In all student records, accuracy and neatness should be insisted upon.

TEXTBOOK (Required)

Hunter and Whitman—Civic Science of Home and Community. (American Book Co.)

OTHER MATERIALS TO BE USED:

Laboratory manuals to help in planning the experimental work.
Charts, models and any other visual instruction helps available.
Current magazines and periodicals.
Laboratory equipment.

- a. A general science demonstration desk in the class room. This should be about four feet three inches high and equipped with necessary appartus. This apparatus should be for the most part simple, because the students will be better able to understand and manipulate less complicated equipment.

SUGGESTED ARRANGEMENT OF TEXTBOOK MATERIALS BY SEMESTERS:

First Semester—

Section I, pp. 11-243. This deals with science of the home and the whole semester is really one large unit to which the smaller units are all related.

Second Semester—

Section II, pp. 243-518. This includes all of Community Science and is one large unit, the smaller units all contributing to the knowledge of science as it affects the community.

BIBLIOGRAPHY FOR TEACHERS

The list on page 8 of textbook is valuable.
H. H. Newman and Others—The Nature of the World and of Man. (University of Chicago Press)
The General Science Quarterly; Salem, Mass.
School Science and Mathematics; 2059 E. 72 Place, Chicago.

BIBLIOGRAPHY FOR STUDENTS

Reference list at the end of each chapter in the textbook.
Periodicals:
  Popular Science Monthly.
  Hygeia—535 N. Dearborn St., Chicago, Ill.
  Popular Mechanics.

ELEMENTARY SCIENCE (SCIENCE 1a)

The aims and pupil activities as developed in General Science if properly applied and directed will serve as well for this course. This is a one-semester course and is much simplified.

TEXTBOOK (Optional)

Caldwell and Meier—Open Doors to Science. (Ginn & Co.)

PHYSICS

AIMS OF PHYSICS:

1. **To form habits of accurate observation of significant facts and phenomena.**
2. **To develop the habit of experimenting before drawing conclusions, and of carrying on these experiments carefully, systematically and intelligently, both as to manipulation of equipment and as to methods used.**
3. **To learn to make careful measurements and to calculate accurately and rapidly.**
4. **To select and present subject matter that will be individually and socially useful.**
5. **To use the types of procedure of highest values and widest application both for the individual and through him to society.**
6. **To develop tastes and appreciation for scientific pursuits, either as vocations or avocations.**
7. **To acquaint pupils with the lives of some of the great leaders who have made contributions to physical science.**

PUPIL ACTIVITIES INTENDED TO REALIZE AIMS:

1. **To form habits of accurate observation of significant phenomena.**
    a. Have students distinguish in their notebooks and reports between important and unimportant facts.
    b. Insist that observations recorded or given be accurate.

2. **To develop the habit of experimenting before drawing conclusions and of carrying on these experiments intelligently, systematically, and carefully, both as to manipulation of equipment and as to methods used.**
    a. Students, when searching for knowledge of phenomena, learn to use eyes, ears and hands before consulting books.
    b. Students should develop a definite plan before beginning an experiment or set of observations.
    c. Have students maintain system, order and neatness in the arrangement of apparatus.
    d. Insist upon a certain amount of good technique.

3. **To learn to make careful measurements and to calculate accurately and rapidly.**
    a. Have students use practical aids in computations such as logarithms, multiplication tables and the slide rule.
    b. Have students develop judgment and make measurements only as accurately as is demanded by the nature of the knowledge sought.
    c. Give a limited number of formal problems, just enough to work out problems arising in laboratory and to enable student to understand the mathematical principles involved.

4. **To select and present the subject matter that will be individually and socially useful.**
    a. Have students make a special study of higher types of vocations in which Physics is fundamental, such as mechanical and electrical professions and trades.

   - b. Emphasize essential points in local applications, leaving out the more complicated applications if the teacher sees fit.

5. **To use the types of procedure of highest values and widest application both for the individual and through him to society.**
   - a. Bear in mind individual differences and adolescent characteristics in work.
   - b. Develop in students scientific ideals that motivate great discoveries and achievements; i. e., a compelling desire to understand and the habit of scientific experimentation.
   - c. Develop scientific insight and powers of interpretation by having students draw conclusions carefully from laboratory work and other observations. Have students as far as possible interpret for themselves.
   - d. Use the small group method (two or three) unless lack of apparatus makes this impossible.

6. **To develop tastes and appreciation for scientific pursuits, either as vocations or avocations.**
   - a. Make field trips to factories and shops where physical principles can be seen in actual use.
   - b. Keep a bulletin board full of interesting articles about Physics.
   - c. Have students develop projects based upon their individual interests.
   - d. Encourage hobbies along scientific lines, have reports on those of special interest.
   - e. Development of Physics, Science or Radio Club as a project.

7. **To acquaint pupils with the lives of some of the great leaders who have made contributions to physical science.**
   - a. Give some time to a study of brief biographies emphasizing those who sacrificed greatly, to make their contribution.

TEXTBOOKS (Required)

Black and Davis—Practical Physics. (Macmillan Co.)
Black—Experiments in Practical Physics. (Macmillan Co.)

OTHER MATERIALS TO BE USED:

Supplementary texts and references.
Notebooks.
Laboratory and equipment necessary for experiments to correlate with text.

SUGGESTED ARRANGEMENT OF TEXTBOOK MATERIALS BY SEMESTERS:

First Semester—

The first ten chapters with the corresponding laboratory work of about twenty-five problems, including all the starred ones.

Second Semester—

Chapters ten to twenty-one with chapters twenty-two and twenty-three used as supplementary reading.

Use the textbook as a guide and not as a master. It is somewhat too comprehensive and some omissions might be made as follows:

1. Static electricity, unless a static machine is available.

2. The details of construction of the modern complicated multiple pole electric generators, both for direct and alternating current.
3. Chapter 23 on electric waves, x-ray, and radio-activity should not be gone into in detail as it is most of it "over the heads" of the pupils.
4. Omit enough laboratory experiments so that those worked out will be understood, choosing those best fitted to the needs of the subject as presented and to the equipment of the laboratory. About 40 experiments is a good number.

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